

Qualifications and Skill Mix of Subcontractor Employees

JPL has provided standardized labor categories and their corresponding requirements for information only to exhibit the type of work categories that are anticipated. Work will be directed on an IDIQ basis. All labor categories may or may not be used during the term of the Subcontract.

Labor Categories

- 1.0 Stress Analyst – Structural Design and Analysis Support including, but not limited to: Finite Element Model Analysis; STS and Other LV Flight Loads Analysis; In-Flight Loads Analysis; Stress Analysis; Dynamic Analysis; Fracture Control; Structures and Materials Analysis, Experience in Mechanical, Aerospace Engineering, Civil Engineering or related discipline, as indicated below
 - 1.1 Stress Analyst I – Ph.D. with two plus (2+) years of experience, or MS with six plus (6+) years of experience in Mechanical Engineering or related discipline, or BS with eight plus (8+) years of experience.
 - 1.2 Stress Analyst II – Ph.D. with four plus (4+) years of experience, or MS with eight plus (8+) years of experience in Mechanical Engineering or related discipline, or BS with ten plus (10+) years of experience.
 - 1.3 Stress Analyst III – Ph.D. with six plus (6+) years of experience, or MS with ten plus (10+) years of experience, or BS with twelve plus (12+) years of experience.

2.0 Thermal, Fluids, and Cryogenic Systems Engineering – Hardware, Analysis, Design Support including, but not limited to: Thermal, Fluids, and Cryogenic Systems Design; Thermal, Fluids, and Cryogenic Systems Analysis; Advanced Thermal, Fluids, and Cryogenic Systems Development; Thermal, Fluid, and Cryogenics Systems Verification and Validation; Thermal, Fluid, and Cryogenics Assembly, Test and Flight Operations; Thermal Coatings Environmental Testing; Thermal Coatings Application; Thermal Blankets Design, Prototyping and Installation, Experience in Mechanical, Aerospace Engineering or related discipline, as indicated below

2.1 Thermal/Fluids/Cryogenic Systems Engineer I – MS, or BS with one (1) year of experience.

Some knowledge of spacecraft and/or instrument thermal control and the associated design process. Educational background and/or working experience in heat transfer, thermodynamics and systems engineering. Ability to develop thermal design with a systems approach. Willingness to become sufficiently skilled with thermal analysis tools including experience with TMG, TSS, Thermal Desktop, and/or Thermal Analysis System.

2.2 Thermal/Fluids/Cryogenic Systems Engineer II – Ph.D., MS with three (3) years of experience or BS with five (5) years of experience.

Working knowledge of spacecraft and/or instrument thermal control and the associated design process. Educational background and/or working experience in heat transfer, thermodynamics and systems engineering. Ability to develop thermal design with a systems approach. Willingness to become sufficiently skilled with thermal analysis tools including experience with TMG, TSS, Thermal Desktop, and/or Thermal Analysis System. Ability to work on at least two concurrent assignments and to actively participate with the design team.

2.3 Thermal/Fluids/Cryogenic Systems Engineer III – Ph.D. with seven (7) years of experience, MS degree with ten (10) years of experience, or BS degree with twelve (12) years of experience.

In-depth working knowledge of spacecraft and/or instrument thermal control and the associated design process including design, analysis, thermal hardware implementation and test. . Educational background and/or working experience in heat transfer, thermodynamics and systems engineering. Possesses experience in leading the design development of a spacecraft subsystem or science instrument. Has demonstrated experience in the design, analysis, implementation and testing of flight thermal designs. Has demonstrated proficiency with thermal analysis tools such as TMG, TSS, Thermal Desktop, and/or Thermal Analysis System. Knowledge of passive and active space borne thermal control techniques for Earth-orbiting and interplanetary missions. Ability to develop thermal design with a systems approach.

3.0 Mechanical Engineering – Mechanical/Electrical Hardware Fabrication Activities and Services Support to include, but not limited to: Mechanisms; Materials and Process Engineering; Mechanical Ground Support Equipment (MGSE); Electrical Ground Support Equipment (EGSE) (cable harness, electronic chassis, electronic modules; Structures (primary and secondary); Prototype and Flight Hardware Protective Coatings, Assembly, Integration, and Test Support; and Working knowledge of CAD design and FEM analysis tools.

3.1 Mechanical Engineer I – MS in Mechanical Engineering or similar discipline or BS degree in similar discipline plus three years of experience.

Strong knowledge in the fundamentals of mechanical engineering. Capabilities in basic design of spacecraft structures, mechanisms, or science instruments.

3.2 Mechanical Engineer II – MS in Mechanical Engineering or similar discipline with six (6) years of experience or BS in similar discipline with eight (8) years of experience.

Proven ability to solve complex mechanical design problems. Able to devise mechanical configurations of complex assemblies. Ability to generate and review complete detailed designs of mechanical assemblies such as actuators, optical benches, and spacecraft structures. Successful experience with coordinating hardware fabrication, assembly and test.

3.3 Mechanical Engineer III – MS or Ph.D. in Mechanical Engineering with ten (10) years work experience.

Proven capability to apply technical skills in solving multi-disciplinary problems. Ability to perform trade studies, develop design and verification requirements, and design complex assemblies. Coordinate fabrication, assembly and test of hardware.

4.0 Mechanical Design – CAD to include, but not limited to: Design Analysis (thermal analysis, stress analysis, fault tree analysis); Design Layout (mechanical drawings, assembly drawings, Interface Control Drawings (ICD), drawing checkout); Experience with space structures, mechanisms, or opto-mechanical packaging.

4.1 Mechanical Designer I – High School Diploma or GED with Two (2) years of experience.

Basic knowledge of the midrange or high-end CAD design tools. Ability to model structures and chassis using parametrics per direction of mechanical engineer. Ability to operate in a PDM controlled environment.

4.2 Mechanical Designer II – High School Diploma or GED with five (5) years of experience.

Comprehensive knowledge of the midrange or high-end CAD design tools. Ability to model parts using parametrics per direction of mechanical engineer. Ability to generate detailed parts drawings and assembly/installation drawings per ANSI Y4.5 standards. Ability to operate in a PDM controlled environment.

- 4.3 Mechanical Designer III – B.S.degree in Mechanical Engineering with 0-5 years experience, or an M.S. degree with 0-3 years experience; or equivalent (High School Diploma or GED with ten (10) years of experience).

Extensive knowledge of multiple midrange or high-end CAD design tools. Ability to translate between tools utilizing industry standard formats (i.e., STEP). Ability to model parts using parametric CAD software, Unigraphics preferred. Can design parts and assemblies with limited engineering direction. Ability to perform system assembly functions within the CAD tool (i.e., mass properties). Ability to generate detailed parts drawings and assembly/installation drawings per ANSI Y4.5 standards. Ability to lead other designers in the development of the system design. Ability to establish and maintain the system PDM environment.

- 4.4 Mechanical Designer IV - B.S. degree in Mechanical Engineering with 5+ years experience, or an M.S. degree with 3+ years experience, or a Ph.D. with 1+ years or experience; or equivalent.

Previous experience in the engineering design field using parametric CAD (computer aided design) software with experience using Unigraphics. Previous experience with engineering modeling, analysis, drawings, and change processes. Previous experience with some form of PDM system for CAD. Knowledge of ASME Y14.5. Solid understanding of mechanical design skills including trade studies. Proven experience in meeting cost and schedule deadlines, and providing options to the design team. Proven ability to work effectively in a high pressure environment.

- 4.5 Mechanical Designer V - B.S. degree in Mechanical Engineering with 10+ years experience, or an M.S. degree with 8+ years experience, or a Ph.D. with 6+ years or experience; or equivalent.

Extensive experience in the engineering design field using parametric CAD (computer aided design) software. Recent experience using Unigraphics. Extensive experience with engineering modeling, analysis, drawings, and change processes. Substantial experience with some form of PDM system for CAD. Intermediate to advanced knowledge of ASME Y14.5. Strong mechanical design skills including trade studies, meeting cost and schedule deadlines, and providing options to the design team.

- 5.0 Electronic Packaging Engineer – Design Support with emphasis on the design and analyses (thermal and mechanical stress) of mechanical/structural packages and printed wiring board modules that host the electronic circuits of the spacecraft and associated ground support equipment; Researches, plans, designs and develops mechanical products such as chassis and housings for electronic systems and subsystems; Uses high-end CAD tools to design and analyze the products; and to include, but not limited to: Design Analysis (thermal analysis, stress analysis); Design Layouts (Electronic packaging, printed wiring boards, electronic chassis, electronic sub-assembly); Detailed drafting and checking

- 5.1 Electronic Packaging Engineer I – Mechanical engineer with two (2) years experience.
- 5.2 Electronic Packaging Engineer II – Mechanical or Aerospace engineering bachelor degree with ten (10) years experience.
- 5.3 Electronic Packaging Engineer III – Mechanical or Aerospace engineering bachelor degree with fifteen (15) years experience.

- 6.0 Printed Wiring Board Layout Designer – Support to include ability to use high-end CAD tools (i.e., Mentor Altium) to capture schematics provided by a JPL electronic engineer, but not be limited to: Design the Printed Wiring Board (PWB) layout, Create the manufacturing drawing package necessary to fabricate and assemble the final assembly.
 - 6.1 Printed Wiring Board Layout Designer I: Two (2) years experience in printed wiring board design using CAD tools. Ability to use high-end CAD tools (i.e., Mentor Altium) to capture schematics provided by a JPL electronic engineer.
 - 6.2 Printed Wiring Board Layout Designer II: Ten (10) years experience in printed wiring board design using CAD tools. Ability to use high-end CAD tools (i.e., Mentor Altium) to capture schematics provided by a JPL electronic engineer.
 - 6.3 Printed Wiring Board Layout Designer III: Fifteen (15) years experience in printed wiring board design using CAD tools.

- 7.0 Optical Engineering – to include, but not be limited to: Optical Systems (Design, Analysis, Prototype Development); Optical System Analysis; Opto-Mechanical System Design (Analysis, Prototype Development)
 - 7.1 Optical Engineer I – BS degree in Physics, Electronic Engineering, or other Engineering or Science discipline with two plus (2+) years of experience.

Ability to design, test, and develop various opto-electrical and/or opto-mechanical components. Familiarity with vacuum systems, optics, and electronics is a plus. Desire familiarity with opto-electronic circuits, computers, opto-mechanical design and analysis, diagnostic techniques and computer control of experiments and optics programs such as Code5 and ZEMAX, etc.
 - 7.2 Optical Engineer II – MS or Ph.D. degree in optics, engineering physics, astronomy, or related technical discipline with two years experience in the field of optics.

Experience in the design and assembly of optical systems. Knowledge of structures and thermal engineering and analysis; image processing; optical metrology; controls or related discipline. Experience in computing in a parallel environment. Demonstrated skills and experience in optical engineering, physics or electrical engineering or in a similar discipline such as astronomy. Good programming skills (FORTRAN, C++, C, IDL, Matlab); good mathematical and analytical skills.

- 7.3 Optical Engineer III – Ph.D. degree in Electrical Engineering or similar discipline with ten (10) years of experience, or MS degree in similar discipline with twelve (12) years of experience, or BS degree in similar discipline with fifteen (15) years of experience.

Direct experience in opto-electrical and opto-mechanical qualification of science instruments on orbiting or interplanetary spacecraft. Understanding of qualification and test issues associated with opto-mechanical and opto-electrical hardware. Concentrated experience in the field of opto-mechanical and opto-electrical compatibility, familiarity with military and NASA specifications. Strong understanding of hardware opto-mechanical and opto-electrical qualification by test and analysis. Basic computer skills with strong knowledge of optical modeling and use of optical programs such as Code V. Hardware test experience.

- 8.0 Propulsion Engineering – to include, but not limited to: Chemical Systems; Electrical Systems; Feed Systems; Solid-propulsion Systems; Hybrid-propulsion Systems; Hardware; Analysis; Thruster Software Development

- 8.1 Propulsion Engineer I: – PhD, MS or BS in mechanical, aerospace, astronautics, chemical, physics with minimum of 1 year experience.

Some knowledge of spacecraft propulsion principles particularly liquid and/or solid propulsion. Educational background and/or working experience in propulsion component or system design, analysis, test and/or integration. Ability to contribute and/or develop skills to support one or more of the following types of propulsion tasks: mission operations support (primarily hydrazine system reaction control systems); propulsion fluids flow analysis; filter analysis, test data reduction and analysis; component development support with senior engineering staff.

- 8.2 Propulsion Engineer II – same degrees as Propulsion Engineer I; PhD with minimum 5 years experience, MS degree with 7 years minimum experience, BS with minimum 10 years experience

Working knowledge of spacecraft and/or launch vehicle propulsion systems. Educational background and/or working experience in chemical and/or solid component or system design, analysis, test and/or integration. Ability to significantly contribute to tasks in support one or more of the following types of propulsion tasks: mission operations support (primarily hydrazine system reaction control systems); propulsion fluids flow analysis; filter analysis, test data reduction and analysis; component development support with senior engineering staff, test documentation, specification development, participate in reviews at vendors/prime contractors, or operations software modification/development.

- 8.3 Propulsion Engineer III – same degrees as Propulsion Engineer I; PhD with minimum 10 years experience, MS degree with minimum of 12 years experience, or BS degree with minimum of 15 years experience

In-depth working knowledge of propulsion in one or more of the following disciplines: chemical, solids, electric or hybrid propulsion. Experience in space flight applications for propulsion. Demonstrated ability to significantly contribute to tasks in a lead or supporting role. Previous experience, demonstrated skills and leadership ability in one or more of the following areas: mission operations, propulsion system design, thruster and/or feed system components, testing, new component or system development efforts, mission operations software related to propulsion, power processing units, digital control interface units, ground support equipment, specification development, participation in major reviews, design validation/verification efforts, conceptual studies, costing experience, and/or dealing with vendors,

- 9.0 Cable/Harness Engineering – to include, but not limited to: Physical Layout (routing, bundle diameter, bend radii, tie-down details, mass estimates); Connector Information (connector selection, mounting detail, wire content); Cable/Harness Interfaces and Field Joints; Cable/Harness Electrical Design (AWG, wire types (single-conductor, twisted pair, coax), shielding (circuit & harness))

- 9.1 Cable/Harness Engineer I: – BA/BS degree in Mechanical Engineering or Electrical Engineering, or a similar discipline with 0-3 years of experience, MA/MS degree with 0-5 years of work experience; or equivalent related technical work experience.

Knowledge of electrical and mechanical design concepts. Familiarity with wire and connectors. Interest in JPL spacecraft electrical/mechanical design processes and procedures. Ability to learn multiple cabling and mechanical CAD tools, such as Mentor Graphics and Unigraphics. Experience with the Microsoft Office tool suite and graphic tools like Visio.

- 9.2 Cable/Harness Engineer II: – Bachelors degree in Mechanical Engineering, or a similar discipline with 5+ years experience, or a Masters with 3+ years experience, or a Ph.D. with 1+ years experience, or equivalent. Demonstrated experience in spacecraft cabling design, fabrication and testing. Prior experience with the JPL process and procedures for delivering and integrating flight cabling in ATLO. Proven ability to oversee budgets and schedules. Proficient in the use of computer databases, CAD drawings and Excel spreadsheets for cabling design and fabrication.

Demonstrated experience in spacecraft cabling design, fabrication and testing. Prior experience with the JPL process and procedures for delivering and integrating flight cabling in ATLO. Proven ability to oversee budgets and schedules. Proficient in the use of computer databases, CAD drawings and Excel spreadsheets for cabling design and fabrication. Experience as Flight Cabling Cognizant Engineer. Experienced with the layout of cabling in complex routing environments. Detailed and hands-on based knowledge of fabrication processes and workmanship criteria for flight and ground support cabling. Experience in working with outside companies and vendors.

- 9.3 Cable/Harness Engineer III: – Bachelors degree with 10+ years experience; or an MS degree with 8+ years experience; or a PhD with 6+ years of experience; or equivalent relevant technical work experience.

Significant experience in the design, fabrication, and assembly of spacecraft, satellite, high reliability military, or instrument printed flex and round wire cabling systems. Substantial knowledge of mechanical and electrical design requirements for printed flex and round wire cabling and the processes for implementing those requirements. Extensive experience leading a team of engineers and designers. Strong experience with the mechanical and electrical packaging design of printed flex cabling in accordance with MIL-P-50884, IPC 2221, and IPC 2223. Substantial experience with JPL specifications, processes, and procedures for the design, fabrication, testing, and integration of flex and round wire cabling. Substantial experience in JPL spacecraft electrical/mechanical design processes and procedures. Strong computer skills in the use of databases, UG NX CAD drawings, and Excel spreadsheets. Extensive experience in task planning, cost control and scheduling. Extensive experience working with customers to develop system specific requirements and tracking those requirements to end product delivery. Strong track record of working with vendors to manage budget and schedule. Substantial experience in the design of printed flex cabling for dynamic applications including flex joints and large angular rotation flex twist capsules. Substantial background in the design, documentation, fabrication, testing, and integration of round wire cabling.

10.0 Contamination Control Engineering Support – to include, but not be limited to

- 10.1 Contamination Control Engineer I: – PhD, MS or BS in chemistry, chemical engineering, mechanical, aerospace, materials, or physics with minimum of 1 year experience.

Some knowledge of spacecraft and/or instrument contamination control and the associated requirements definition, interaction during design, and/or hardware processing issues. Educational background and/or working experience in chemistry, materials, and/or mechanical. Ability to help implement contamination control plans.

- 10.2 Contamination Control Engineer II: – same degrees as Contamination Control Engineer 1; PhD with minimum 3 years experience, MS degree with minimum of 5 years experience, or BS degree with minimum of 7 years experience

Working knowledge of spacecraft, instrument and/or launch vehicle contamination control engineering. Educational background and/or working experience in contamination control as associated with spacecraft systems, optical systems, chemical detection sensors, and/or sensitive thermal surfaces. Ability to significantly contribute to tasks in support one or more of the following types of contamination control tasks: contamination control plan preparation, outgas/bakeout test documentation, cleaning methodologies, specification development, contamination modeling, design team participation, material list reviews, clean room operation, participation in reviews at vendors/prime contractors, and/or launch site integration monitoring/oversight with respect to contamination control.

- 10.3 Contamination Control Engineer III: – same degrees as Contamination Control Engineer 1; PhD with minimum 7 years experience, MS degree with minimum of 10 years experience, or BS degree with minimum of 12 years experience.

In depth working knowledge of contamination control for space assets. Experience in contamination control for spacecraft and/or flight instrument systems. Demonstrated ability to significantly contribute to tasks in a lead or supporting role. Previous experience, demonstrated skills and leadership ability in one or more of the following areas: contamination control plan preparation, assessment of susceptibility of sensors to contamination, means to effectively and practically reduce contamination on critical surfaces, clean room operation and monitoring, contamination testing, contamination modeling, materials characteristics associated with contamination potential, cleaning technologies for various hardware applications, hardware integration impacts on contamination control, launch vehicle environments, launch site operations impacts on contamination control and participation in preliminary and critical reviews.